# PATENT SPECIFICATION

583,842

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COMPLETE SPECIFICATION

## Improvements in or relating to Combined Light-Filtering and Light-Polarizing Means

We, INTERNATIONAL POLAROID CORPORATION, a corporation organized under the laws of the State of New Jersey, United States of America, of 400, 38th Street, Union City, State of New Jersey, United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to light-filtering means in combination with light-polarizing elements.

It is an object of the present invention to provide such means which will substantially polarize all light within at least one wave-length band within the visible range of the spectrum, while at the same time substantially completely absorbing all infra-red and ultra-violet radiation.

A further object is to provide a light filter having the above properties but in which isotropic and dichroic materials are combined in the same carrier medium and in a single stratum.

A still further object is to provide a window for sun glasses or other anti-glare viewing devices incorporating a filter of the above type.

According to the invention there is provided a light-filter comprising a plastic layer having light polarizing material which substantially completely polarizes light throughout at least one wave-length band within the visible spectrum and an isotropic material forming a filter for light in a wave-length band adjacent the visible spectrum and being different from said light polarizing material, the two materials being present within a single stratum.

A preferred form of the invention consists in a light-filter comprising a plastic layer having light-polarizing material which substantially completely polarizes light throughout the visible spectrum and an isotropic material forming a filter for light in a wave-length band adjacent the visible spectrum and being different from said light polarizing material, the two materials being present within a single stratum and the combination being such that the intensity of the light transmitted throughout the visible specrum is substantially uniform.

In order that the invention may be readily understood and carried into effect it will now be described with reference to the accompanying drawings, illustrating several embodiments thereof and in which:

Figure 1 represents an enlarged cross-section of a laminated light-filtering and polarizing combination constructed in accordance with the invention;

Fig. 2 is a similar view showing a modified form of laminated light-filtering and polarizing combination according to the invention;

Fig. 3 is a perspective view, partly broken away, of a pair of sun glasses embodying windows constructed in accordance with the present invention;

Fig. 4 is a view in section on the line 4—4 in Fig. 3; and

Fig. 5 illustrates diagrammatically absorption curves of the elements of an ideal type of light-filtering and polarizing combination constructed in accordance with the invention.

A combination having the above characteristics may advantageously be produced in the form of laminated structures, such for example, as those shown in Figs. 1 and 2. In Fig. 1, element 10 represents a layer of polarizing material bonded between outer layers 12 of glass or other transparent material, by means such as adhesive layers 14.

The layer 10 comprises any polarizing material which is available in thin sheet-like form. These include suspensions of optically oriented polarizing particles in transparent plastic materials, dichroically dyed or stained sheets of molecularly oriented linear hydrophilic polymeric plastic materials, and plastic materials containing oriented dichroic molecules of the type described, for example, in British Patent Specification No. 548,759. All such sheet-like light-polarizing materials are now available under the Registered Trade Mark "Polaroid".

Among the materials suitable for use in layers 12, there may be mentioned glass, plastic materials of the type sold under the Registered Trade Mark " Plexiglas ", sheet cellulosic compounds, and other similar media.

Adhesive layers 14 comprise any of a variety of isotropic materials such as highly polymerized vinyl acetate, or a polymerized plasticized vinyl acetal resin, or polyvinyl alcohol, or polymerized methyl methacrylate, or other suitable adhesive.

The layer 10 has incorporated therein an isotropic dye or dyes forming a filter having the desired light-absorption properties.

Fig. 2 illustrates a modified form of the type of filter shown in Fig. 1, comprising essentially a three-ply laminated structure made without the use of separate adhesive layers. Element 20 represents the polarizing layer which substantially completely polarizes light throughout at least one wave-length band within the visible spectrum and comprises any desired dichroic material such as those mentioned above in connection with layer 10. Outer layers 22 comprise any transparent material which may be secured directly to layer 20 without the use of separate adhesive layers. If, for example, layer 20 is formed of a sheet of cellulose acetate containing oriented dichroic crystals, layers 22 may comprise sheets of transparent cellulose acetate secured directly thereto. The layer 20 contains a material acting as a filter for light in a wave-length band adjacent the visible spectrum.

Figs. 3 and 4 illustrate a pair of sun glasses 30, comprising a conventional frame 32 and temples 34, and provided with a pair of windows 35. As is shown more clearly in Fig. 4, windows 35 comprise a polarizing layer 40 which substantially completely polarizes light throughout at least one wave-length band within the visible spectrum corresponding to elements 10 and 20 in Figs. 1 and 2, respectively, between outer layers 42, of transparent material and may or may not include adhesive layer 44, depending on the materials used. Preferably layers 42 will be of glass, and layers 44 comprise any of the adhesive materials mentioned in connection with Fig. 1. Layer 40 also contains a material which acts as a filter for light in a wave-length band adjacent the visible spectrum, as is described in more detail hereinafter. It will be noted that windows 35 are preferably so oriented in frame 32 as to absorb incident polarized light vibrating in a horizontal plane, that is, with the transmission axes of layers 40 perpendicular to the horizontal, as is indicated by arrow 45.

Fig. 5 illustrates diagrammatically absorption curves of an ideally perfect filtering and polarizing combination in accordance with the present invention and which would be particularly adapted for use in sun glasses or similar anti-glare viewing devices. In this diagram the abscissæ indicate wavelengths in millimicrons and the ordinates the density of the elements of the combination for the two resolved vibration components of light incident thereon. For the purposes of this invention, the ultra-violet range of the spectrum is considered to be from about 300 to 400 millimicrons, the visible range from about 400 to 760 millimicrons, and the infra-red range from about 760 to about 1100 millimicrons, for the reason that these ranges include substantially all the radiation emanating from the sun, and all rays within said ranges are considered as being properly defined as " light " rays.

In Fig. 5, curve 50 represents the sum of the densities of the two members of the light-filtering combination for the resolved vibration component which is, in part, absorbed by the polarizing element of the combination, that is to say, the component vibrating perpendicularly to the transmission axis of the polarizing material, and it will be noted that said density is indicated as being uniformly high throughout all the illustrated wave-length range. Curve 55 represents the sum of the densities of the two members of the light-filtering combination for the resolved vibration component which is wholly transmitted by the polarizing element of the combination, that is to say, the component vibrating parallel to the transmission axis of the polarizing material. It will be noted that this curve is also relatively high in the infra-red and ultra-violet portions of the spectrum but drops to a uniformly low value throughout the visible range of the spectrum. In other words, such a combination substantially completely absorbs all infra-red and ultra-violet radiation and substantially completely polarizes all light within the visible range of the spectrum. A filtering and polarizing combination having such absorption curves would be ideal for use in sun glasses under conditions of bright natural light, for it would absorb all the harmful infra-red and ultra-violet rays. At the same time, if it were oriented with its transmission axis perpendicular to the horizontal, as indicated by arrows 45 in Fig. 3, it would absorb all light polarized by reflection to vibrate in a horizontal

plane, which is the glare-producing component. However, under ordinary conditions, the absorption curves may merely be approximated, and various combinations of materials for producing such approximations will now be described in detail.

In one embodiment of the invention, an infra-red absorbing material is present in the light-polarizing material. For example, a dye such as Naphthol Green B or Luxol Fast Green B may be incorporated in polyvinyl alcohol which is to be converted into polarizing material either by the method described in British Patent Specification No. 548,759, or by staining with a suitable dichroic dye such, for example, as a polarizing polyiodide or a suitable direct cotton dye or dyes.

With respect to the absorption of ultra-violet radiation, it should be pointed out that the crystal suspension type of polarizing material sold under the Registered Trade Mark "Polaroid" possesses the property of almost complete absorption of ultra-violet radiation. Accordingly, it is unnecessary to provide an additional ultra-violet absorber with such material.

If one of the other polarizing materials mentioned above is used in the practice of the invention, a separate ultra-violet-absorbing dye or substance may be incorporated in the polarizing layer in the laminated combination. For example, if polarizing layer 10 (Fig. 1) or 20 (Fig. 2) comprises polyvinyl alcohol, *p*-hydroxybenzaldehyde may be added directly thereto. It should also be pointed out that ultra-violet radiation is to a considerable extent absorbed by both of the dyes mentioned above, namely, Naphthol Green B and Luxol Fast Green B. Many other combinations will doubtless be apparent to one skilled in the art and are to be construed as being within the scope of this invention and of the appended claims.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A light-filter comprising a plastic layer having light polarizing material which substantially completely polarizes light throughout at least one wave length band within the visible spectrum and an isotropic material forming a filter for light in a wave-length band adjacent the visible spectrum and being different from said light polarizing material, the two materials being present within a single stratum.

2. A light-filter comprising a plastic layer having light-polarizing material which substantially completely polarizes light throughout the visible spectrum and an isotropic material forming a filter for light in a wave-length band adjacent the visible spectrum and being different from said light polarizing material, the two materials being present within a single stratum and the combination being such that the intensity of the light transmitted throughout the visible spectrum is substantially uniform.

3. A combination according to either of claims 1 or 2, in which both ultra-violet and infra-red light rays are filtered out.

4. A combination according to any one of the preceding claims, comprising a material which substantially completely polarizes light throughout the visible spectrum while substantially completely absorbing ultra-violet radiation, said material being dyed with a dye which substantially completely absorbs infra-red radiation.

5. A combination according to any one of the preceding claims, in which the plastic layer is arranged between sheets of transparent material.

6. A combination according to claim 5, in which the plastic layer is bonded to the sheets of transparent isotropic material.

7. A combination according to either of claims 5 or 6, in which a plastic layer is located between glass layers.

8. Sun glasses including a light filter according to any one of the preceding claims.

9. A light-filter substantially as hereinbefore described with reference to either of Fig. 1 or 2 of the accompanying drawings.

10. Sun-glasses substantially as hereinbefore described with reference to Figs. 3 and 4 of the accompanying drawings.

Dated this 17th day of January, 1942.

For:
INTERNATIONAL POLAROID CORPORATION,
Stevens, Langner, Parry & Rollinson,
Chartered Patent Agents,
5/9, Quality Court, Chancery Lane,
London, W.C.2, and at
120, East 41st Street, New York 17, New York, U.S.A.

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FIG. 1

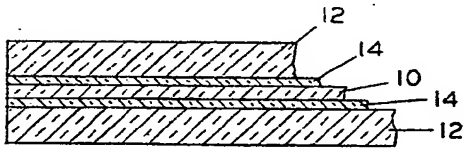



FIG. 2

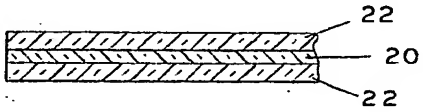



FIG. 3

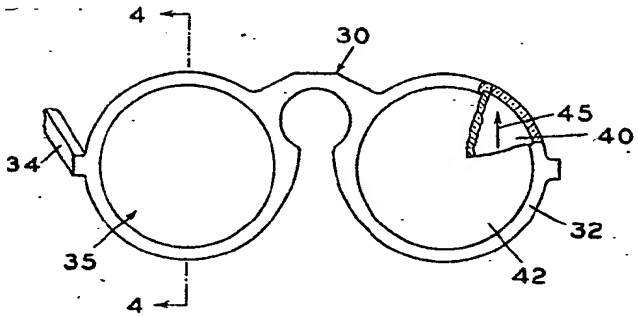



FIG. 4

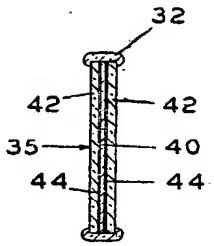
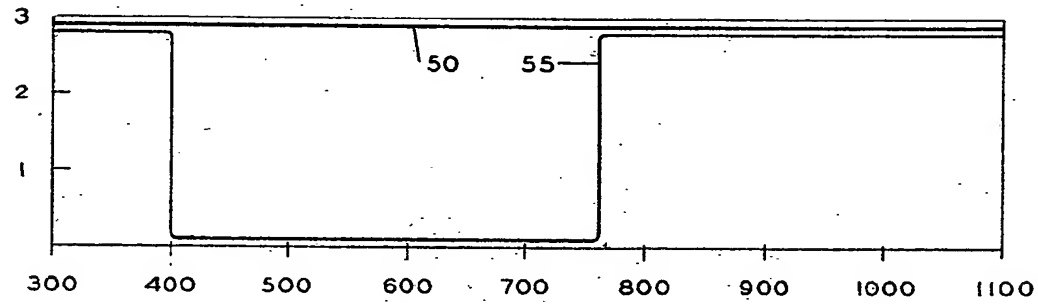



FIG. 5




H.M.S.O. (Ty.P.)